Space News Update – December 2017

By Pat Williams

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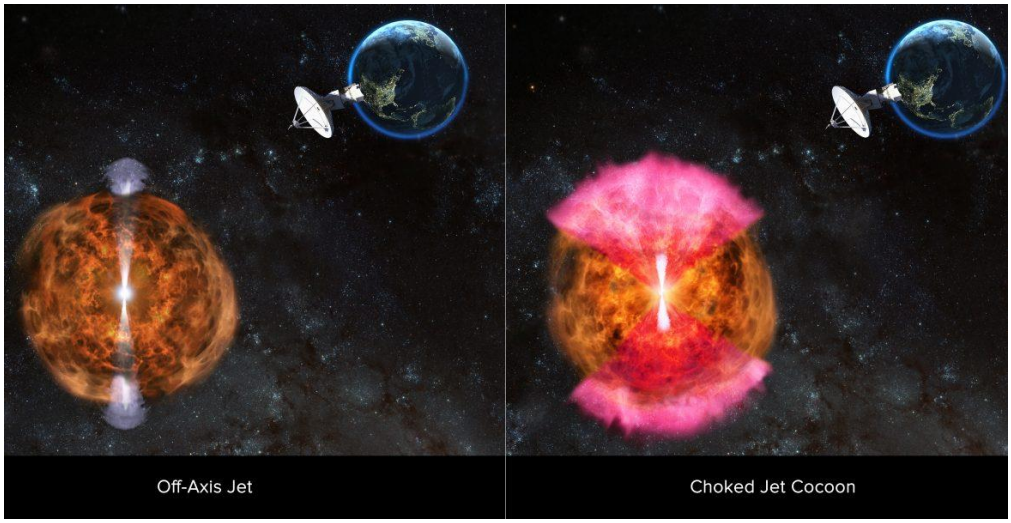
Disclaimer - I claim no authorship for the printed material; except where noted (PW).

NEW SPACE POLICY DIRECTIVE CALLS FOR HUMAN EXPANSION ACROSS SOLAR SYSTEM

Representatives of Congress and the National Space Council joined President Donald J. Trump, Apollo astronaut Jack Schmitt and current NASA astronaut Peggy Whitson Monday, Dec. 11, 2017, for the president's signing of Space Policy Directive 1, a change in national space policy that provides for a U.S.-led, integrated program with private sector partners for a human return to the Moon, followed by missions to Mars and beyond.
Credits: NASA/Aubrey Gemignani

President Donald Trump is sending astronauts back to the Moon. He signed Space Policy Directive 1, a change in national space policy that provides for a U.S.-led, integrated program with private sector partners for a human return to the Moon, followed by missions to Mars and beyond. The policy calls for the NASA administrator to "lead an innovative and sustainable program of exploration with commercial and international partners to enable human expansion across the solar system and to bring back to Earth new knowledge and opportunities." The effort will more effectively organize government, private industry, and international efforts toward returning humans on the Moon, and will lay the foundation that will eventually enable human exploration of Mars. In addition to the direction to plan for human return to the Moon, the policy also ends NASA's existing effort to send humans to an asteroid. (NASA)
New Space Policy Directive calls for human expansion across solar system
(11 December 2017)

RADIO OBSERVATIONS POINT TO LIKELY EXPLANATION FOR NEUTRON-STAR MERGER PHENOMENA

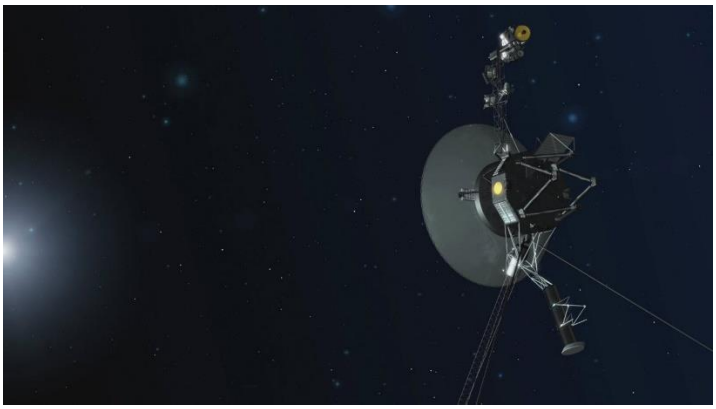


Credit: NRAO/AUI/NSF: D. Berry

Three months of observations with the National Science Foundation's Karl G. Jansky Very Large Array (VLA) have allowed astronomers to zero in on the most likely explanation for what happened in the aftermath of the violent collision of a pair of neutron stars in galaxy 130 million light-years from Earth. What they learned means that astronomers will be able to see and study many more such collisions. On August 17, 2017, the LIGO and VIRGO gravitational-wave observatories combined to locate the faint ripples in spacetime caused by the merger of two super-dense neutron stars. It was the first confirmed detection of such a merger and only the fifth direct detection ever of gravitational waves, predicted more than a century ago by Albert Einstein. The gravitational waves were followed by outbursts of gamma rays, X-rays, and visible light from the event. The VLA detected the first radio waves coming from the event on September 2. This was the first time any astronomical object had been seen with both gravitational waves and electromagnetic waves. The timing and strength of the electromagnetic radiation at different wavelengths provided scientists with clues about the nature of the phenomena created by the initial neutron-star collision. Prior to the August event, theorists had proposed several ideas, theoretical models, about these phenomena. As the first such collision to be positively identified, the August event provided the first opportunity to compare predictions of the models to actual observations. Astronomers using the VLA, along with the Australia Telescope Compact Array and the Giant Metrewave Radio Telescope in India, regularly observed the object from September onward. The radio telescopes showed the radio emission steadily gaining strength. Based on this, the astronomers identified the most likely scenario for the merger's aftermath. The gradual brightening of the radio signal indicates we are seeing a wide-angle outflow of material, traveling at speeds comparable to the speed of light, from the neutron star merger. The observed measurements are helping the astronomers figure out the sequence of events triggered by the collision of the neutron stars. The initial merger of the two super-dense objects caused an explosion, called a kilonova, that propelled a spherical shell of debris outward. The neutron stars collapsed into a remnant, possibly a black hole, whose powerful gravity began pulling material toward it. That material formed a rapidly-spinning disk that generated a pair of narrow, superfast jets of material flowing outward from its poles. If one of the jets were pointed directly toward Earth, we would have seen a short-duration gamma-ray burst, like many seen before. That clearly was not the case. Some of the early measurements of the August event suggested instead that one of the jets may have been pointed slightly

away from Earth. This model would explain the fact that the radio and X-ray emission were seen only some time after the collision. That simple model, of a jet with no structure (a so-called top-hat jet) seen off-axis, would have the radio and X-ray emission slowly getting weaker. As we watched the radio emission strengthening, we realized that the explanation required a different model. The astronomers looked to a model published in October by Mansi Kasliwal of Caltech, and colleagues, and further developed by Ore Gottlieb, of Tel Aviv University, and his colleagues. In that model, the jet does not make its way out of the sphere of explosion debris. Instead, it gathers up surrounding material as it moves outward, producing a broad "cocoon" that absorbs the jet's energy. The astronomers favored this scenario based on the information they gathered from using the radio telescopes. Soon after the initial observations of the merger site, the Earth's annual trip around the Sun placed the object too close to the Sun in the sky for X-ray and visible-light telescopes to observe. For weeks, the radio telescopes were the only way to continue gathering data about the event. If the radio waves and X-rays both are coming from an expanding cocoon, we realized that our radio measurements meant that, when NASA's Chandra X-ray Observatory could observe once again, it would find the X-rays, like the radio waves, had increased in strength. Mooley and his colleagues posted a paper with their radio measurements, their favored scenario for the event, and this prediction online on November 30. Chandra was scheduled to observe the object on December 2 and 6. On December 7, the Chandra results came out, and the X-ray emission had brightened just as we predicted. The agreement between the radio and X-ray data suggests that the X-rays are originating from the same outflow that's producing the radio waves. An important implication of the cocoon model is that we should be able to see many more of these collisions by detecting their electromagnetic, not just their gravitational, waves. (NRAO)
Radio observations point to likely explanation for neutron-star merger phenomena
(20 December 2017)

VOYAGER 1 FIRES UP THRUSTERS AFTER 37 YEARS

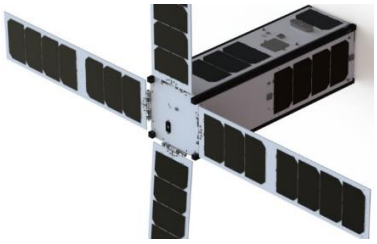


An artist concept depicting one of NASA's twin Voyager spacecraft. Humanity's farthest and longest-lived spacecraft are celebrating 40 years in August and September 2017.

The Voyager spacecraft were built by JPL, which continues to operate both. JPL is a division of Caltech in Pasadena. California. The Voyager missions are a part of the NASA Heliophysics System Observatory, sponsored by the Heliophysics Division of the Science Mission Directorate in Washington.
Voyager 1, NASA's farthest and fastest spacecraft, is the only human-made object in interstellar space, the environment between the stars. The spacecraft, which has been flying for 40 years, relies on small devices called thrusters to orient itself so it can communicate with Earth. These thrusters fire in tiny pulses, or "puffs," lasting mere milliseconds, to subtly

rotate the spacecraft so that its antenna points at our planet. The team waited eagerly as the test results travelled through space, taking 19 hours and 35 minutes to reach an antenna in Goldstone, California. Now, the Voyager team can use a set of four backup thrusters, dormant since 1980. With these thrusters that are still functional after 37 years without use, we will be able to extend the life of the Voyager 1 spacecraft by two to three years. (JPL)
Voyager 1 fires up thrusters after 37 years (1 December 2017)

CLYDE SPACE JOINS AAC MICROTEC



Clyde Space is delighted to have joined the Swedish space tech company AAC Microtec to create a global-leading company in the high-growth market of small and nanosatellites. The combination creates a foundation for accelerated growth, creating long-term opportunities for space industry development and job creation in Scotland, Sweden and other priority markets. It will create opportunities to expand the workforce and capture market share in a fast-growing market.
Clyde Space Joins Aac Microtec (22 December 2017)

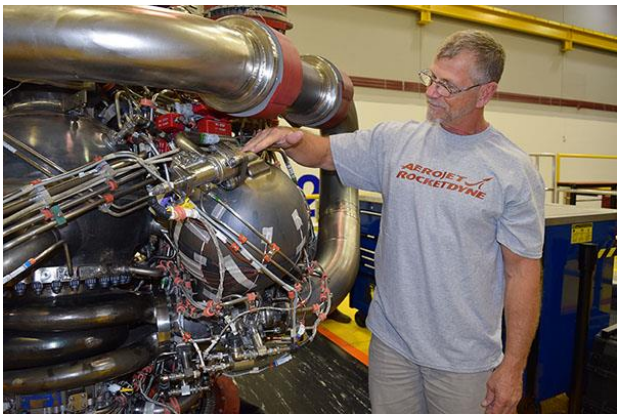
CYGNUS SPACECRAFT SUCCESSFULLY CONCLUDES EIGHTH CARGO SUPPLY MISSION TO THE INTERNATIONAL SPACE STATION

The OA-8 Cygnus, named S.S. Gene Cernan, is captured by the International Space Station's robotic Canadarm2. Photo Credit: NASA

Orbital ATK (NYSE: OA), a global leader in aerospace and defense technologies, today announced that its "S. S. Gene Cernan" Cygnus™ spacecraft successfully completed its eighth cargo supply mission to the International Space Station under NASA's Commercial Resupply Services (CRS-1) contract. The mission, known as OA-8, achieved significant milestones that further demonstrated the versatility and value of the Cygnus spacecraft.

Cygnus acted as an extension of the space station for the first time by supporting science experiments inside the cargo module while docked to the laboratory. The Cygnus spacecraft also removed approximately 6,400 pounds (2,900 kilograms) of items for disposal, marking the largest amount of material removed by the spacecraft during its cargo resupply missions. The "S. S. Gene Cernan" then executed flawlessly on secondary missions that included the deployment of a record 14 CubeSats into orbit from a NanoRacks CubeSat deployer.
The OA-8 mission officially concluded on December 18 at 7:54 am EST when Cygnus performed a safe, destructive reentry into the Earth's atmosphere over the Pacific Ocean east of New Zealand. The spacecraft remained docked for 22 days at the orbiting laboratory and departed the space station on December 6. (Orbital ATK)
Cygnus spacecraft successfully concludes eighth cargo supply mission to the International Space Station (18 December 2017)
First commercial payloads onboard New Shepard (21 December 2017)
Blue Origin, a privately funded aerospace company founded by Jeff Bezos, successfully took 25 customers on a short space trip last week aboard the company's Crew Capsule 2.0 spacecraft. This was the seventh mission the company's New Shepard rocket has flown and was aptly called Mission 7 (M7).Blue Origin is known for being pretty secretive about the aerospace projects it undertakes, but M7 achieved a huge milestone by take carrying 12 commercial, research, and education experiments along with the customers. This a lot like the experiments that are sent to the International Space Station (ISS), only to a much smaller degree. The flight only lasted 11 minutes and got as high as 100,000 kilometers in the air. During that time the customers experienced microgravity environments that astronauts would during take-off. This allowed them to conduct some quick experiments in a low-gravity environment, something that's hard to achieve down here on Earth. (Blue Origin)

RS-25 ENGINE TEST IS GIANT STEP FOR 3-D PRINTING



An Aerojet Rocketdyne technician inspects the 3-D printed pogo accumulator assembly on an RS-25 development engine at the Aerojet Rocketdyne facility located at NASA's Stennis Space Center

Aerojet Rocketdyne and NASA completed hot-fire testing of an RS-25 rocket engine containing its largest additively manufactured component to date. Additive manufacturing, commonly known as 3-D printing, will help lower the cost of future missions of NASA's powerful Space Launch System (SLS) heavy-lift rocket. This test demonstrates the viability of using additive manufacturing to produce even the most complex components in one of the world's most reliable rocket engines. We expect this technology to dramatically lower the cost of access to space. (Aerojet Rocketdyne)
RS-25 engine test is giant step for 3-D printing (13 December 2017)

LINKS TO OTHER SPACE NEWS PUBLISHED IN DECEMBER 2017

ASTROPHYSICS

First results from Microscope satellite confirm Albert Einstein's theory of relativity with unprecedented precision (4 December 2017)
Measurements of the equivalence principle had not been improved upon for 10 years, but now the first results from CNES's Microscope satellite, equipped with accelerometers supplied by the French aerospace research agency ONERA, are 10 times better. They show, with an unprecedented precision of 2.10-14, that bodies in a vacuum fall with the same acceleration. The equivalence principle has so far proved unshakeable and this result simply reconfirms the theory of general relativity postulated by Albert Einstein over a century ago. According to this theory, time and space are interwoven in a four-dimensional space-time fabric warped by gravitation. It has been verified experimentally recently with the detection of gravitational waves. But the quantum field theory, another leading theory of the 20th century that faithfully describes the world of particles and the infinitely small, would seem to be irreconcilable with general relativity. A universal theory unifying gravitation and quantum physics is therefore the holy grail of physicists in the 21st century. Certain candidate theories predict that the principle of the equivalence between gravitation and acceleration, at the heart of the theory of general relativity, could be violated at very weak levels. Microscope is pushing this principle to its limits and yielding new indications to constrain the theory of general relativity. (CNES)

NASA's SuperTIGER balloon flies again to study heavy cosmic particles (6 December 2017)
A science team in Antarctica is preparing to loft a balloon-borne instrument to collect information on cosmic rays, high-energy particles from beyond the solar system that enter Earth's atmosphere every moment of every day. The instrument, called the Super Trans-Iron Galactic Element Recorder (SuperTIGER), is designed to study rare heavy nuclei, which hold clues about where and how cosmic rays attain speeds up to nearly the speed of light. The launch is expected by Dec. 10, weather permitting. Roughly 20 percent of cosmic rays were thought to arise from massive stars and supernova debris, while 80 percent came from interstellar dust and gas with chemical quantities similar to what's found in the solar system. Within the last few years, it has become apparent that some or all of the very neutron-rich elements heavier than iron may be produced by neutron star mergers instead of supernovas. Neutron stars are the densest objects scientists can study directly, the crushed cores of massive stars that exploded as supernovas. Neutron stars orbiting each other in binary systems emit gravitational waves, which are ripples in space-time predicted by Einstein's general theory of relativity. These waves remove orbital energy, causing the stars to draw ever closer until they eventually crash together and merge. Theorists calculated that these events would be so thick with neutrons they could be responsible for most of the very neutron-rich cosmic rays heavier than nickel. Observations by the Hubble and Spitzer space telescopes indicate that large amounts of heavy elements were formed in the event.
It's possible neutron star mergers are the dominant source of heavy, neutron-rich cosmic rays, but different theoretical models produce different quantities of elements and their isotopes. The only way to choose between them is to measure what's out there, and that's what we'll be doing with SuperTIGER. (NASA Goddard)

BLACK HOLES

Most distant black hole (6 December 2017)
Scientists have uncovered a rare relic from the early universe: the farthest known supermassive black hole. This matter-eating beast is 800 million times the mass of our Sun, which is astonishingly large for its young age. This black hole grew far larger than we expected in only 690 million years after the Big Bang, which challenges our theories about how black holes form. Astronomers combined data from NASA's Wide-field Infrared Survey Explorer (WISE) with ground-based surveys to identify potential distant objects to study, then followed up with Carnegie Observatories' Magellan telescopes in Chile. For black holes to become so large in the early universe, astronomers speculate there must have been special conditions to allow rapid growth - but the underlying reason remains mysterious. The newly found black hole is voraciously devouring material at the center of a galaxy -- a phenomenon called a quasar. This quasar is especially interesting because it comes from a time when the universe was just beginning to emerge from its dark ages. The discovery will provide fundamental information about the universe when it was only 5 percent of its current age. (JPL)

DWARF PLANETS

A new spin to solving mystery of stellar companions (4 December 2917)
The researchers compared the spin rates for the five companions to those measured previously for small free-floating brown dwarfs. The ranges of rotation rates for the two populations were indistinguishable. In other words, the companions are whirling about their own axes at about the same speeds as their free-floating brown-dwarf counterparts. The results suggest two possibilities. One is that the planetary-mass companions are brown dwarfs. The second possibility is that the companions looked at in this study are planets that formed, just as planets do, out of disks of material swirling around their stars, but for reasons not yet understood, the objects ended up with spin rates like those of brown dwarfs. Some researchers think that both newly forming planets and brown dwarfs are encircled by miniature gas disks that might be helping to slow their spin rates. In other words, similar physical processes may leave planets and brown dwarfs with similar spin rates.
Spin rates of planetary-mass bodies outside our solar system have not been fully explored. We are just now beginning to use this as a tool for understanding formation histories of planetary-mass objects. (Caltech)

Bright areas on Ceres suggest geologic activity (12 December 2017)
The surface of dwarf planet Ceres would generally look quite dark, but with notable exceptions. These exceptions are the hundreds of bright areas that stand out in images Dawn has returned. Now, scientists have a better sense of how these reflective areas formed and changed over time - processes indicative of an active, evolving world. The mysterious bright spots on Ceres reveal evidence of Ceres' past subsurface ocean, and indicate that, far from being a dead world, Ceres is surprisingly active. Geological processes created these bright areas and may still be changing the face of Ceres today. (JPL)

EARTH

Sentinel-5P brings air pollution into focus (1 December 2017)
Launched on 13 October, the Sentinel-5P satellite has delivered its first images of air pollution. Even though the satellite is still being prepared for service, these first results have

been hailed as exceptional and show how this latest Copernicus satellite is set to take the task of monitoring air quality into a new era. One of these first images shows nitrogen dioxide over Europe. Caused largely by traffic and the combustion of fossil fuel in industrial processes, the high concentrations of this air pollutant can be seen over parts of the Netherlands, the Ruhr area in western Germany, the Po Valley in Italy and over parts of Spain. (ESA)

Galileo satellites for Arianespace's December 12 mission are ready for launcher integration (1 December 2017)
Galileo is the European initiative to develop a global satellite navigation system. Under civilian control, it will offer a guaranteed, high-precision positioning service and features innovative technologies developed in Europe for the benefit of all citizens. (Arianespace)

Earth-i to use KSAT's ground stations to receive first commercial full-colour video from space (1 December 2017)

Earth-i is building the first constellation in the world able to provide full-colour video – and the first European-owned constellation able to provide both video and still images. This constellation will be a major leap forward for the Earth Observation industry providing many innovative capabilities including:

- The provision of high-frame rate images with resolutions better than one metre for any location on Earth.
- The ability to film moving objects such as vehicles, vessels and aircraft in ultra-high-definition colour video.
- Revisiting the same location multiple times per day with agile satellites that can be pointed to image specific areas of interest.
- Rapid tasking of satellites to take images or video, and fast data download within minutes of acquisition.

Footage recorded by Earth-i's fleet of satellites will be available for analysis within minutes of being taken and will improve decision-making and response times in a wide variety of scenarios from change detection to object identification, from disaster response to infrastructure monitoring. (Earth-i)

ViaSat-2 satellite reaches geostationary orbit; successfully receives and transmits first data from space (5 December 2017)
The ViaSat-2 satellite system is expected to significantly improve speeds, reduce costs and expand the footprint of broadband services across North America, Central America, the Caribbean and a portion of northern South America, as well as the primary aeronautical and maritime routes across the Atlantic Ocean between North America and Europe. ViaSat-2 is a geostationary satellite that operates in Ka-band frequencies. It was designed to offer high-capacity connectivity and wide coverage, with the flexibility to move capacity to where demand requires it. As compared to ViaSat-1, ViaSat-2 is expected to double the bandwidth, with more than 300 Gigabits per second (Gbps) of total network capacity, as well as provide seven times the broadband coverage. (ViaSat)

NOAA's GOES-S weather satellite arrives at NASA's Kennedy Space Center for launch preparation (8 December 2017)
Like the other satellites in the series, GOES-S carries a suite of sophisticated Earth-sensing, lightning-detecting, solar imaging and space weather monitoring instruments. The advanced technology on board GOES-S will provide critical data and imagery in near-real time on severe weather events such as thunderstorms, tornadoes, hurricanes and flash floods, as well

as hazards like fog, aerosols, dust storms, volcanic eruptions and forest fires. (Lockheed Martin)

Adieu GRACE-FO (12 December 2017)
Both GRACE-FO research satellites are scheduled for launch in spring 2018, and will be placed in a polar orbit of around 500 kilometres and with a distance of 220 kilometres between them. The mission is planned to last at least five years. The satellites will constantly measure the distance between each other to within a few microns using a microwave system built at JPL. At the same time, a sensitive accelerometer will account for non-gravitational effects, such as atmospheric drag and solar radiation. The data will be used to track the movement of liquid water, ice and land masses by creating monthly maps of the changes in Earth's gravitational field. The GRACE-FO satellites will also feature a new inter-satellite laser ranging instrument which will be tested for use in future generations of satellites. In addition, each satellite will record up to 200 profiles per day of temperature distribution and water-vapour content in the atmosphere and the ionosphere to aid weather forecasting. (Airbus)

Six-decade-old space mystery solved with shoebox-sized satellite (13 December 2017)
A 60-year-old mystery regarding the source of some energetic and potentially damaging particles in Earth's radiation belts is now solved using data from a shoebox-sized satellite built and operated by CU Boulder students. The results from the new study indicate energetic electrons in Earth's inner radiation belt—primarily near its inner edge—are created by cosmic rays born from explosions of supernovas. Earth's radiation belts, known as the Van Allen belts, are layers of energetic particles held in place by Earth's magnetic field.
The team showed, during a process called "cosmic ray albedo neutron decay" (CRAND), cosmic rays entering Earth's atmosphere collide with neutral atoms, creating a "splash," which produces charged particles, including electrons, that become trapped by Earth's magnetic fields. The findings have implications for understanding and better forecasting the arrival of energetic electrons in near-Earth space, which can damage satellites and threaten the health of space-walking astronauts. (NSF)

NOAA's GOES-16, now at GOES-East, ready to improve forecasts even more
(18 December 2017)
Now in its new GOES-East position, the advanced GOES-16 satellite has officially joined NOAA's operational observation network, providing forecasters with sharper, more defined images of severe storms, hurricanes, wildfires and other weather hazards in near real-time 24/7. (NOAA)

SSTL ships RemoveDEBRIS mission for ISS launch (18 December 2017)
Once in orbit the ADR experiments on board the spacecraft will be performed. In the first of two capture experiments a net will be discharged at one of the deployed target CubeSats to demonstrate net capture in space. The second capture experiment will see a harpoon launched at a deployable target plate made of representative satellite panel materials – the first harpoon capture in orbit. The third experiment involves vision-based navigation by deploying the second CubeSat and demonstrating rendezvous navigation using cameras and a LiDaR. Finally, the RemoveDEBRIS spacecraft will deploy a large drag sail to speed de-orbit, where it will burn up as it enters Earth's atmosphere. (SSTL)

EXOPLANETS

Earth-like conditions in little-known exoplanet (5 December 2017)
A University of Toronto PhD student has found that a little-known exoplanet called K2-18b could be a "super-Earth," and in the process discovered a new planet in the same solar system. The researcher, who had set a goal to discover a new exoplanet for his thesis, made the discovery by scouring data collected by the European Southern Observatory (ESO).
Both planets orbit K2-18, a red-dwarf star located about 111 light-years away in the constellation Leo. When the planet K2-18b was first discovered in 2015, it was found to be orbiting within the star's habitable zone, making it an ideal candidate to have liquid surface water, a key element in harbouring conditions for life as we know it. (University of Toronto)

First light for ESPRESSO - the next generation planet hunter (6 December 2017)
The Echelle SPectrograph for Rocky Exoplanet and Stable Spectroscopic Observations (ESPRESSO) has successfully made its first observations. Installed on ESO's Very Large Telescope (VLT) in Chile, ESPRESSO will search for exoplanets with unprecedented precision by looking at the minuscule changes in the light of their host stars. For the first time ever, an instrument will be able to sum up the light from all four VLT telescopes and achieve the light collecting power of a 16-metre telescope. (ESO)

Cold suns, warm exoplanets and methane blankets (11 December 2017)
Somewhere in our galaxy, an exoplanet is probably orbiting a star that's colder than our sun, but instead of freezing solid, the planet might be cozy warm thanks to a greenhouse effect caused by methane in its atmosphere. NASA astrobiologists from the Georgia Institute of Technology have developed a comprehensive new model that shows how planetary chemistry could make that happen. (Georgia Tech)

Mars mission sheds light on habitability of distant planets (13 December 2017)
The brightness of a red dwarf at extreme ultraviolet (UV) wavelengths combined with a close orbit would mean that a hypothetical planet would get hit with about 5 to 10 times more UV radiation than the real Mars does. That cranks up the amount of energy available to fuel the processes responsible for atmospheric escape. Calculations indicate that the planet's atmosphere could lose 3 to 5 times as many charged particles, a process called ion escape. About 5 to 10 times more neutral particles could be lost through a process called photochemical escape, which happens when UV radiation breaks apart molecules in the upper atmosphere. Because more charged particles would be created, there also would be more sputtering, another form of atmospheric loss. Sputtering happens when energetic particles are accelerated into the atmosphere and knock molecules around, kicking some of them out into space and sending others crashing into their neighbors, the way a cue ball does in a game of pool. Finally, the hypothetical planet might experience about the same amount of thermal escape, also called Jeans escape. Thermal escape occurs only for lighter molecules, such as hydrogen. Mars loses its hydrogen by thermal escape at the top of the atmosphere. On the exo-Mars, thermal escape would increase only if the increase in UV radiation were to push more hydrogen to the top of the atmosphere. Altogether, the estimates suggest that orbiting at the edge of the habitable zone of a quiet M-class star, instead of our Sun, could shorten the habitable period for the planet by a factor of about 5 to 20. For an M-star whose activity is amped up like that of a Tasmanian devil, the habitable period could be cut by a factor of about 1,000—reducing it to a mere blink of an eye in geological terms. The solar storms alone could zap the planet with radiation bursts thousands of times more intense than the normal activity from our Sun. (JPL)

Artificial intelligence, NASA data used to discover eighth planet circling distant star
(14 December 2017)
Our solar system now is tied for most number of planets around a single star, with the recent discovery of an eighth planet circling Kepler-90, a Sun-like star 2,545 light-years from Earth. The planet was discovered in data from NASA's Kepler Space Telescope. The newly-discovered Kepler-90i – a sizzling hot, rocky planet that orbits its star once every 14.4 days – was found using machine learning from Google. Machine learning is an approach to artificial intelligence in which computers "learn." In this case, computers learned to identify planets by finding in Kepler data instances where the telescope recorded signals from planets beyond our solar system, known as exoplanets. (JPL)

Arianespace chosen by ESA to launch CHEOPS, the CHaracterising ExOPlanet Satellite
(19 December 2017)
CHEOPS will target nearby, bright stars already known to have planets orbiting around them. Through high-precision monitoring of a star's brightness, scientists will examine the transit of a planet as it passes briefly across the star's face. In turn, this will allow an accurate measurement of the planet's radius. For those planets with a known mass, the density will be revealed, providing an indication of the internal structure. (Arianespace)

GALAXIES

Galaxy orbits in the Local Supercluster (7 December 2017)
A team of astronomers from Maryland, Hawaii, Israel, and France has produced the most detailed map ever of the orbits of galaxies in our extended local neighbourhood, showing the past motions of almost 1400 galaxies within 100 million light years of the Milky Way. The team reconstructed the galaxies' motions from 13 billion years in the past to the present day. The main gravitational attractor in the mapped area is the Virgo Cluster, with 600 trillion times the mass of the Sun, 50 million light years from us. Over a thousand galaxies have already fallen into the Virgo Cluster, while in the future all galaxies that are currently within 40 million light years of the cluster will be captured. Our Milky Way galaxy lies just outside this capture zone. However, the Milky Way and Andromeda galaxies, each with 2 trillion times the mass of the Sun, are destined to collide and merge in 5 billion years.
(University of Hawaii)

Telescopes team up to study giant galaxy (12 December 2017)
Astronomers have used two Australian radio telescopes and several optical telescopes to study complex mechanisms that are fuelling jets of material blasting away from a black hole 55 million times more massive than the Sun. "As well as the plasma that's fuelling the large plumes of material the galaxy is famous for, we found evidence of a galactic wind that's never been seen—this is basically a high-speed stream of particles moving away from the galaxy's core, taking energy and material with it as it impacts the surrounding environment," By comparing the radio and optical observations of the galaxy the team also found evidence that stars belonging to Centaurus A existed further out than previously thought and were possibly being affected by the winds and jets emanating from the galaxy. (ICRAR)

'Cosmic lantern' could help us further understand the fate of the Universe
(20 December 2017)
New research has provided a deeper insight into emission line galaxies, used in several ongoing and upcoming surveys, to help us further understand the composition and fate of the Universe. The quest to determine the nature of both dark matter and dark energy has led

scientists to adopt new tracers of the large-scale structure of the Universe, such as emission line galaxies. These galaxies present strong emission lines from the gas heated up by newly formed stars. (University of Portsmouth)

INTERNATIONAL SPACE STATION

Departure of Cygnus cargo spacecraft from International Space Station (30 November 2017)
After delivering almost 7,400 pounds of cargo to support dozens of science experiments from around the world, the Orbital ATK Cygnus cargo spacecraft is set to leave the International Space Station on Wednesday, Dec. 6. NASA Television and the agency's website will provide live coverage of Cygnus' departure beginning at 7:45 a.m. EST. (NASA)

Orbital ATK's Cygnus spacecraft departs International Space Station, begins secondary mission in space (6 December 2017)
Cygnus departed from the International Space Station on December 6 at 8:11 a.m. EST following a highly successful stay at the orbiting laboratory. The spacecraft is packed with approximately 6,400 pounds of disposable cargo, the largest amount of material ever removed by Cygnus during its cargo resupply missions. After its departure, the S.S. Gene Cernan successfully released 14 CubeSats from a NanoRacks CubeSat deployer on board. The OA-8 mission is expected to end on December 18 when Cygnus will execute a safe, destructive re-entry into Earth's atmosphere over the Pacific Ocean.
(Orbital ATK)

Schedule for Dragon cargo resupply mission (13 December 2017)
Packed with almost 4,800 pounds of research, crew supplies and hardware, the SpaceX Dragon spacecraft will launch on a Falcon 9 rocket from Space Launch Complex 40 at Cape Canaveral Air Force Station in Florida. About 10 minutes after launch, Dragon will reach its preliminary orbit and deploy its solar arrays. A carefully choreographed series of thruster firings will bring the spacecraft to rendezvous with the space station Sunday, Dec. 17. NASA astronauts Mark Vande Hei and Joe Acaba will capture Dragon using the space station's robotic arm. Ground controllers then will send commands to robotically install the spacecraft on the station's Harmony module. The Dragon spacecraft will spend approximately one month attached to the space station, returning to Earth in mid-January with results of previous experiments. (NASA)

NASA astronaut Bresnik and crewmates return to Earth from space station
(14 December 2017)
Three crew members who have been living and working aboard the International Space Station returned to Earth on Thursday, landing in Kazakhstan after opening a new chapter in the scientific capability of humanity's premier microgravity laboratory. Together, the Expedition 53 crew members contributed to hundreds of experiments in biology, biotechnology, as well as Earth and other physical sciences aboard the orbiting laboratory. Their time aboard marked the first long-term increase in crew size on the U.S. segment of the International Space Station from three to four, allowing NASA to maximize time dedicated to research on the station. Highlights from the research conducted while they were aboard include investigations of microgravity's effect on the antibiotic resistance of E. coli, a bacterial pathogen responsible for urinary tract infection in humans and animals; growing larger versions of an important protein implicated in Parkinson's disease; and delivering a new instrument to address fundamental science questions on the origins and history of cosmic rays. (NASA)

Planting oxygen (15 December 2017)
When resources are limited, you have to work with what you have – especially in the harsh environment of space. Though the International Space Station is regularly restocked by cargo vessels self-sufficient spaceflight in the future will require us to recycle and reuse precious resources like oxygen. An experiment on its way to space will look into doing just that. Researchers are studying how photosynthesis – the process by which organisms convert light into energy, producing oxygen as a by-product – takes place in space.
They loaded the microalgae *Arthrospira,* commonly known as spirulina, into a photobioreactor, a kind of cylinder bathed in light. On the Space Station, carbon dioxide will be transformed by photosynthesis into oxygen and edible biomass such as proteins. Though a routine process on Earth, we must understand how it works in space before we can exploit it. The experiment will run for a month as the amount of oxygen from the algae is accurately measured. (ESA)

NASA sends new research to space station aboard SpaceX resupply mission
(15 December 2017)
Research materials flying inside Dragon's pressurized area include an investigation demonstrating the benefits of manufacturing fiber optic filaments in a microgravity environment. The investigation will attempt to pull fiber optic wire from ZBLAN, a heavy metal fluoride glass commonly used to make fiber optic glass. Results from this investigation could lead to the production of higher-quality fiber optic products for use in space and on Earth. NASA's Total and Spectral Solar Irradiance Sensor, or TSIS-1, will measure the Sun's energy input to Earth. TSIS-1 measurements will be three times more accurate than previous capabilities, enabling scientists to study the Sun's natural influence on Earth's ozone, atmospheric circulation, clouds and ecosystems. These observations are essential for a scientific understanding of the effects of solar variability on the Earth system. The Space Debris Sensor (SDS) will measure the orbital debris environment around the space station for two to three years. Once mounted on the exterior of the station, this one-square-meter sensor will provide near-real-time debris impact detection and recording. Research from this investigation could help lower the risks posed by orbital debris to human life and critical hardware.
For more than 17 years, humans have lived and worked continuously aboard the International Space Station, advancing scientific knowledge and demonstrating new technologies, making research breakthroughs not possible on Earth that will enable long-duration human and robotic exploration into deep space. A global endeavor, more than 200 people from 18 countries have visited the unique microgravity laboratory that has hosted more than 2,100 research investigations from researchers in more than 95 countries. (NASA)

NASA, international partners ready new research facility for space station
(13 December 2017)
The new Life Sciences Glovebox slots into the storage rack that will house it aboard the International Space Station. The new glovebox facility, to be used for studies of cell biology, disease research and other scientific pursuits, is 26 inches high, 35 inches wide and 24 inches deep, with a 15-cubic-foot workspace. It features two 10-inch-diameter glove ports in the front window, two 8-inch-diameter ports on the right side and two 6-inch-diameter ports on the left side. The Life Sciences Glovebox is slated to be launched incrementally to the space station in 2018 by a series of commercial rockets. (NASA Marshall)

JUPITER AND MOONS

NASA's Juno probes the depths of Jupiter's Great Red Spot (11 December 2017)
Juno data indicate that the solar system's most famous storm is almost one-and-a-half Earths wide, and has roots that penetrate about 200 miles (300 kilometers) into the planet's atmosphere. (JPL)

Giant storms cause palpitations in Saturn's atmospheric heartbeat (13 December 2017)
These patterns—known as the Quasi-Periodic Oscillation (QPO) on Saturn and the Quasi-Quadrennial Oscillation (QQO) on Jupiter, due to their similarities to Earth's so-called Quasi-Biennial Oscillation (QBO)—appear to be a defining characteristic of the middle layers of a planetary atmosphere. (ESA)

NASA solves how a Jupiter jet stream shifts into reverse (18 December 2017)
The team found that the equatorial jet extends quite high into Jupiter's stratosphere. Because the measurements covered such a large region, the researchers could eliminate several kinds of atmospheric waves from being major contributors to the QQO, leaving gravity waves as the primary driver. Their model assumes gravity waves are produced by convection in the lower atmosphere and travel up into the stratosphere, where they force the QQO to change direction. (NASA Goddard)

LAUNCH SERVICES

Arianespace orbits four more Galileo satellites (12 December 2017)
Arianespace has successfully launched satellites 19, 20, 21 and 22 in the Galileo constellation, using an Ariane 5 heavy launcher on behalf of the European Commission (DG GROW) and under a contract with the European Space Agency (ESA). (Arianespace)

Important milestone reached in the construction of the Ariane 6 launch facilities
(15 December 2017)
The new European launch vehicle ARIANE 6 is to embark on its maiden flight from the Kourou space center in French Guiana in July 2020. MT Aerospace AG, a subsidiary of Bremen-based space technology group OHB SE, and its Mainz-based subsidiary MT Mechatronics GmbH are constructing the mechanical launch facilities (ELA 4) in the Amazon region in a contract for the French space agency CNES. With the successful completion of the critical design review at the end of November, Europe has come one important step closer to completing the ground facilities for the new launch vehicle. (MT Aerospace)

MARS

NASA Mars rover team's tilted winter strategy works (6 December 2017)
NASA's senior Mars rover, Opportunity, has just passed the shortest-daylight weeks of the long Martian year with its solar panels in encouragingly clean condition for entering a potential dust-storm season. Besides tilt and daylight length, other factors in Opportunity's power status include how much dust is on the solar array and in the sky. Wind can clean some dust off the array, but can also stir up dust storms that block sunlight and then drop dust onto the rover. Southern-hemisphere autumn and winter tend to have clear skies over Opportunity, but the amount of dust on the solar array going into autumn has varied year-to-year, and this year the array was dustier than in all but one of the preceding autumns. (JPL)

Clay minerals on Mars may have formed in primordial steam bath (6 December 2017)
The steam atmosphere associated with a magma ocean could have survived for as long as 10 million years or more. That would have been long enough to create as much as three kilometers of clay on the primordial Martian surface. To get an idea what the fate of that clay might be as the planet evolved, the researchers created a computer model to simulate a slab of Martian crust with a three-kilometer clay layer on top. Then they simulated the first billion years of Martian geologic history - the period when volcanic activity and asteroid bombardment were most prevalent. The model showed that the burial, excavation and scattering of clays over time created distribution of exposed deposits similar to what's seen on Mars today. Clays cover about 3 percent of the oldest crust exposures on Mars. They are finding about that same order of magnitude in these models. The lab experiments and simulations can't say for certain that this scenario occurred, but they do suggest a strong hypothesis that could be tested during future Mars exploration. (Brown University)

Mars' atmosphere well protected from the solar wind (7 December 2017)
Despite the absence of a global Earth-like magnetic dipole, the Martian atmosphere is well protected from the effects of the solar wind on ion escape from the planet. New research shows these using measurements from the Swedish particle instrument ASPERA-3 on the Mars Express spacecraft. The results presented in the thesis show that a stronger solar wind mainly accelerates particles already escaping the planet's gravity, but does not increase the ion escape rate. Contrary to previous assumptions, the induced magnetosphere is also shown to protect the bulk of the Martian ionosphere from solar wind energy transfer.
(Swedish Institute of Space Physics)

Meteorites from Mars suffer a velocity boost due to the material pileup (11 December 2017)
Researchers have performed numerical simulations to explore the launch mechanism of the Martian meteorites. According to the knowledge of shock physics, a strong shock compression higher than 50 GPa is required to accelerate Martian materials up to the escape velocity of Mars (5 km/s). In contrast, detailed analysis of Martian meteorites shows that they suffer only 30–50 GPa during the ejection. The researchers found that a material pileup in an excavation flow causes a significant velocity boost of materials near the surface without strong compression. This newly discovered "late-stage acceleration" could play an important role not only in the launch of Martian meteorites, but also in the context of the (Litho-Panspermia. (Chiba Institute of Technology; Tokyo Institute of Technology)

Three new crew members on voyage to International Space Station (17 December 2017)
The Soyuz spacecraft carried NASA's Scott Tingle, Anton Shkaplerov of the Russian space agency Roscosmos, and Norishige Kanai of the Japan Aerospace Exploration Agency. The arrival of Tingle, Shkaplerov and Kanai will restore the station's crew complement to six. They will join Expedition 54 Commander Alexander Misurkin of Roscosmos and his crewmates, Mark Vande Hei and Joe Acaba of NASA. The crew members will spend more than four months conducting approximately 250 science investigations in fields such as biology, Earth science, human research, physical sciences and technology development. Vande Hei, Acaba and Misurkin are scheduled to remain aboard the station until February 2018, and Tingle, Shkaplerov and Kanai are scheduled to return to Earth in April.
This crew continues the long-term increase in crew size on the U.S. segment from three to four, allowing NASA to maximize time dedicated to research on the space station. Highlights of upcoming investigations include demonstrating the benefits of manufacturing fiber optic filaments in a microgravity environment, a new study looking at structures that are vital to the design of advanced optical materials and electronic devices and examining a drug compound

and drug delivery system designed to combat muscular breakdown in space or during other prolonged periods of disuse, such as extended bed rest on Earth. (NASA)

Mars: not as dry as it seems (20 December 2017)
Although today's Martian surface is barren, frozen and inhabitable, a trail of evidence points to a once warmer, wetter planet, where water flowed freely. The conundrum of what happened to this water is long standing and unsolved. New research suggests that this water is now locked in the Martian rocks. Scientists propose that the Martian surface reacted with the water and then absorbed it, increasing the rocks oxidation in the process, making the planet uninhabitable. (University of Oxford)

MOON/S

An orbital dance may help preserve oceans on icy worlds (30 November 2017)
Heat generated by the gravitational pull of moons formed from massive collisions could extend the lifetimes of liquid water oceans beneath the surface of large icy worlds in our outer solar system, according to new NASA research. This greatly expands the number of locations where extraterrestrial life might be found, since liquid water is necessary to support known forms of life and astronomers estimate there are dozens of these worlds.
(NASA Goddard)

Thales Alenia Space partners in NextSTEP-2 adventure to support human spaceflight in the vicinity of the Moon (14 December 2017)
Thales Alenia Space support to the US partner's activities in NextSTEP is primarily focused on the definition of a key core element of the Cislunar infrastructure, i.e. the Habitat Module, but with potential additional contributions in terms of general deep space gateway architecture and other composing elements, such as a potential airlock. This support will span from overall module configuration to layout, structures, micro-meteoroid and radiation protection, thermal control and more in general systems aspects (including manufacturing and integration capabilities) essential for the technical definition of such modules and for the setup of development approach and planning able to meet the stringent schedule of the program. (Thales Alenia Space)

PLUTO

New Horizons corrects its course in the Kuiper Belt (9 December 2017)
NASA's New Horizons spacecraft carried out a short, 2.5-minute engine burn on Saturday, Dec. 9 that refined its course toward 2014 MU69, the ancient Kuiper Belt object it will fly by a little more than a year from now. Setting a record for the farthest spacecraft course correction to date, the engine burn also adjusted the arrival time at MU69 to optimize flyby science. (Johns Hopkins University Applied Physics Laboratory)

QUASARS

Herschel data links mysterious quasar winds to furious starbursts (7 December 2017)
Astronomers have observed absorption lines in many quasars that are indicative of absorption *en route* by cool gas with heavy metal elements like carbon, magnesium and silicon. The lines signal that the light has travelled through winds of cold gas travelling at speeds of thousands of kilometres per second within the quasars' host galaxies. Whilst knowledge that

these winds exist is nothing new, their origin, and why they can reach such impressive speeds, has remained an unknown. Researchers have shed light on the cold winds' origins. Using data obtained with ESA's Herschel Space Observatory the astronomers have shown, for the first time, that the strength of the metal absorption lines associated with these mysterious gas winds is directly linked to the rate of star formation within the quasar host galaxies. In finding this trend the astronomers can say with some confidence that prodigious star formation within the host galaxy may be the mechanism driving these mysterious and powerful winds. This new connection not only solves one puzzle about quasars but may also contribute to unravelling an even bigger mystery: why does the size of galaxies observed in our Universe appear to be capped in practice, although not in theory. Although theories predict that galaxies can grow very large, ultra-massive galaxies have not been observed. It appears that there is a process which acts as a brake on the formation of such galaxies: internal gas winds for example could be responsible for this so-called negative feedback. (ESA)

STARS AND STAR CLUSTERS

Neutron stars on the brink of collapse (4 December 2017)
In neutron star collisions, two neutron stars orbit around each other, eventually merging to form a star with approximately twice the mass of the individual stars. In this cosmic event, gravitational waves – oscillations of spacetime – whose signal characteristics are related to the mass of the stars, are emitted. This event resembles what happens when a stone is thrown into water and waves form on the water's surface. The heavier the stone, the higher the waves. All models that lead to the direct collapse of the merger remnant can be ruled out because a collapse leads to the formation of a black hole, which in turn means that relatively little light is emitted during the collision. However, different telescopes have observed a bright light source at the location of the stars' collision, which provides clear evidence against the hypothesis of collapse. The results thereby rule out many models of neutron star matter, namely all models that predict a neutron star radius smaller than 10.7 kilometers. However, the internal structure of neutron stars is still not entirely understood. The radii and structure of neutron stars are of interest not only to astrophysicists, but also to nuclear and particle physicists because the inner structure of these stars reflects the properties of high-density nuclear matter found in every atomic nucleus. (Heidelberg Institute for Theoretical Studies)

Giant bubbles on red giant star's surface (20 December 2017)
Astronomers using ESO's Very Large Telescope have for the first time directly observed granulation patterns on the surface of a star outside the Solar System - the ageing red giant π1 Gruis. The remarkable new image from the PIONIER instrument reveals the convective cells that make up the surface of this huge star, which has 350 times the diameter of the Sun. Each cell covers more than a quarter of the star's diameter and measures about 120 million kilometres across. Located 530 light-years from Earth in the constellation of Grus (The Crane), π1 Gruis is a cool red giant. It has about the same mass as our Sun, but is 350 times larger and several thousand times as bright. Our Sun will swell to become a similar red giant star in about five billion years. An international team of astronomers used the PIONIER instrument on ESO's Very Large Telescope to observe π1 Gruis in greater detail than ever before. They found that the surface of this red giant has just a few convective cells, or granules, that are each about 120 million kilometres across - about a quarter of the star's diameter. Just one of these granules would extend from the Sun to beyond Venus. The

surfaces, known as photospheres, of many giant stars are obscured by dust, which hinders observations. However, in the case of π1 Gruis, although dust is present far from the star, it does not have a significant effect on the new infrared observations. (ESO)

Winking' star may be devouring wrecked planets (21 December 2017)
RZ Piscium is located about 550 light-years away in the constellation Pisces. During its erratic dimming episodes, which can last as long as two days, the star becomes as much as 10 times fainter. It produces far more energy at infrared wavelengths than emitted by stars like our Sun, which indicates the star is surrounded by a disk of warm dust. In fact, about 8 percent of its total luminosity is in the infrared, a level matched by only a few of the thousands of nearby stars studied over the past 40 years. This implies enormous quantities of dust. These and other observations led some astronomers to conclude that RZ Piscium is a young Sun-like star surrounded by a dense asteroid belt, where frequent collisions grind the rocks to dust. But the evidence was far from clear. An alternative view suggests the star is instead somewhat older than our Sun and just beginning its transition into the red giant stage. A dusty disk from the star's youth would have dispersed after a few million years, so astronomers needed another source of dust to account for the star's infrared glow. Because the aging star is growing larger, it would doom any planets in close orbits, and their destruction could provide the necessary dust. So, which is it, a young star with a debris disk or a planet-smashing stellar senior? According to the research it is a bit of both. (NASA Goddard)

SUN

State-of-the-art solar reference spectrum (19 December 2017)
For almost a decade, the International Space Station tracked the Sun to measure our star's energy. Solspec, part of the Solar package on the International Space Station, was launched with the European Columbus space laboratory in 2008 and tracked the Sun until it was shut down this year. It measured the energy of each wavelength in absolute terms and its variability. The more accurate it is, the better researchers can understand how our climate has changed and is changing. Solar power plants also use the reference data to predict how much electricity they will generate, to work out how many solar panels should be installed and to fine-tune their facilities. (ESA)

TECHNOLOGY

MT Mechatronics awarded engineering contract for the Giant Magellan Telescope
(8 December 2017)
A contract for the construction of a 40-meter radio telescope from the National Astronomical Research Institute of Thailand (NARIT) in Chiang Mai. The telescope is a turning-head model operating in a frequency range of between 5 and 100 GHz and is to go into operation in 2020 in northern Thailand close to the NARIT headquarters. Alongside the 40-meter telescope that MTM has also assembled for the Instituto Geográfico Nacional in Spain, it is one of the largest and most powerful telescopes of its type. NARIT plans to operate various receivers in the range from 5 to 100 GHz. (MT Mechatronics)

RUAG Space will continue to build the brain of each Galileo satellite (11 December 2017)
On the mechanical side, RUAG Space will supply the mechanisms used to align the Galileo satellites' solar array. As a satellite orbits the Earth, it continuously changes its alignment to the sun. Special mechanisms known as SADMs (Solar Array Drive Mechanisms) ensure that

the solar array precisely tracks these changes to obtain the maximum energy yield by optimizing the orientation of the solar cells relative to the sun. (RUAG Space)

Prometheus to power future launchers (14 December 2017)
An ultra-low-cost reusable rocket engine, Prometheus, using liquid oxygen–methane propellants, is set to power Europe's future launchers. (ESA)

NASA laser communication payload undergoing integration and testing (15 December 2017)
NASA's Laser Communications Relay Demonstration (LCRD) mission has begun integration and testing at NASA's Goddard Space Flight Center in Greenbelt, Maryland. The mission will demonstrate how a transition from radio to laser communications will exponentially improve the way we connect with astronauts and spacecraft. Laser communications could provide 10 to 100 times better data rates than radio due to higher bandwidth. This means that laser communications can transmit more data at a time than radio, even though both communication types can only travel as fast as the speed of light. To transmit a one-foot resolution "Google map" of the entire Martian surface, the best radio frequency communications system would take nine years to send all the data. Laser communications could do it in nine weeks. Additionally, laser communications systems take up much less area and weight for the same (or better) data rates than radio systems. (NASA Goddard)

Graphene in zero-G promises success in space (15 December 2017)
Graphene's excellent thermal properties are promising for improving the performance of loop heat pipes, thermal management systems used in aerospace and satellite applications. Graphene could also have a use in space propulsion, due to its lightness and strong interaction with light. The Graphene Flagship successfully tested both these applications in recent experiments in November and December 2017. Graphene is one of the most interesting and versatile materials known to date. The world's first two-dimensional material, this single layer of carbon atoms arranged in a hexagonal lattice has a set of unique and outstanding properties. As well as being the thinnest, strongest and lightest material, graphene is flexible, impermeable to molecules and extremely electrically and thermally conductive.
(Graphene Flagship)

CERN hosts ESA for high-energy radiation experiments (19 December 2017)
An ESA-led group subjected components and space equipment to the most intense beam of ultra-high energy heavy ions available – short of travelling into space – during a week-long visit to CERN, the European Organization for Nuclear Research.
Test items were placed in a path of an experimental beamline fed by the Super Proton Synchrotron (SPS) particle accelerator. Located in a circular tunnel nearly 7 km in circumference, the SPS is CERN's second largest accelerator after the Large Hadron Collider (LHC), which the SPS feeds into in turn. ESA was invited to make use of the Geneva-based centre's beamline as part of an ESA–CERN cooperation agreement signed by their respective Director Generals. (ESA)

Prototype space sensors take test ride on NASA ER-2 (20 December 2017)
Scientists recently completed test flights with prototypes of potential satellite sensors over the Western United States, probing basic science questions about aerosols, clouds, air quality and global ocean ecosystems. The flight campaign, called Aerosol Characterization from Polarimeter and Lidar (ACEPOL), sought to test capabilities of several proposed instruments for the Aerosol-Cloud-Ecosystem (ACE) pre-formulation study. Aerosols are small solid or liquid particles suspended in Earth's atmosphere, like fine dust, smoke, pollen or soot. These

particles scatter and absorb sunlight and are critical to the formation of clouds and precipitation. Scientists can analyse this scattered light using instruments like polarimeters, which measure the colour and polarization of the scattered light, and lidars, which use lasers to probe the atmosphere. Together these data sets provide key information about aerosol properties, including size, shape and chemical composition - information that provides a better understanding and assessment of their effects on weather, climate and air quality. (JPL)

Restore-L on-orbit servicing mission passes NASA design review (20 December 2017)
SSL-built space platform, on track for 2020 launch, first-ever with ability to refuel satellites in low-Earth orbit, jumpstarting new U.S. satellite servicing industry. (SSL)

ESA's next satellite propelled by butane (21 December 2017)
ESA's next miniature satellite will be its first able to change orbit. Thanks to a compact thruster resembling a butane cigarette lighter, the cereal box-sized satellite will fly around its near-twin to test their radio communications. (ESA)

Stratolaunch completes first low-speed taxi test (18 December 2017)
On January 6 and 7, the Scaled Composites LLC (Mojave, CA, US) test team successfully executed a low speed taxi test of the giant Stratolaunch aircraft. During this initial taxi test, the aircraft moved down the runway under its own power for the first time. These first test points have demonstrated the fundamental ability to control the aircraft speed and direction on the runway. Scaled Composites has been working with Stratolaunch for the past five years designing, building, and testing the world's largest aircraft. Microsoft co-founder and businessman Paul Allen's mission for Stratolaunch is developing an air launch platform to make access to space more convenient, reliable, and routine. (Stratolaunch)

UNIVERSE

Map reveals location of mysterious fast-moving gas (4 December 2017)
An Australian scientist has created the most detailed map ever of clouds of high-velocity gas in the Universe around us. The map covers the entire sky and shows curious clouds of neutral hydrogen gas that are moving at a different speed to the normal rotation of the Milky Way. At least 13 per cent of the sky is covered by high-velocity clouds. These gas clouds are moving towards or away from us at speeds of up to a few hundred kilometres per second. (International Centre for Radio Astronomy Research)

Pat Williams. December 2017